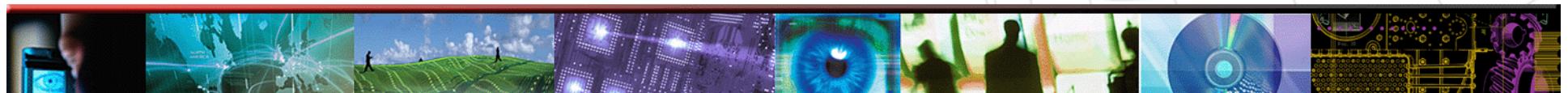


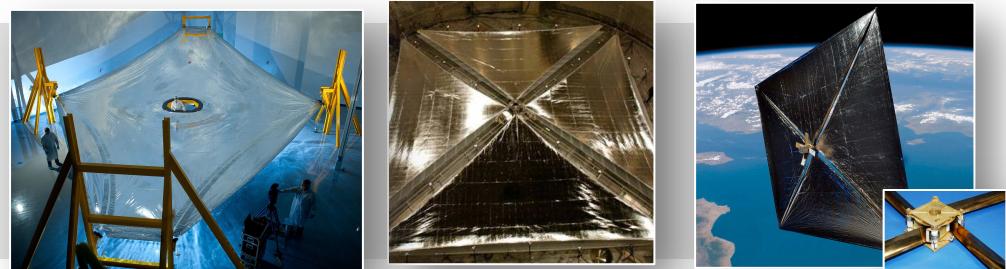
Electro-dynamic Propulsion Operations Beyond the Ionosphere

Dr. Nobie Stone – ManTech/NeXolve Corporation



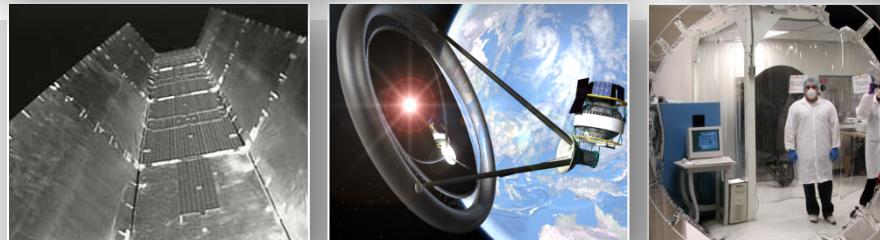
Ultra light Membrane Systems

- JWST Sunshield
- Solar Sails
- Trac Booms and Drag Devices



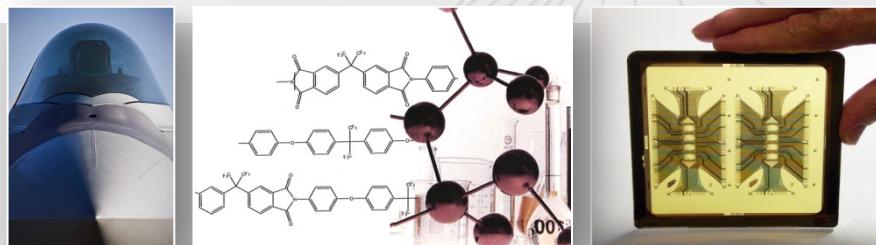
High Performance Antenna Components and Lightweight Reflectors

- PV Array power boosters
- Inflatable concentrators
- Directed energy reflectors



Advanced Polymer Materials

- UV, ozone protection
- Extreme temperature stability (>300 C)
- Zero CTE and controlled CTE

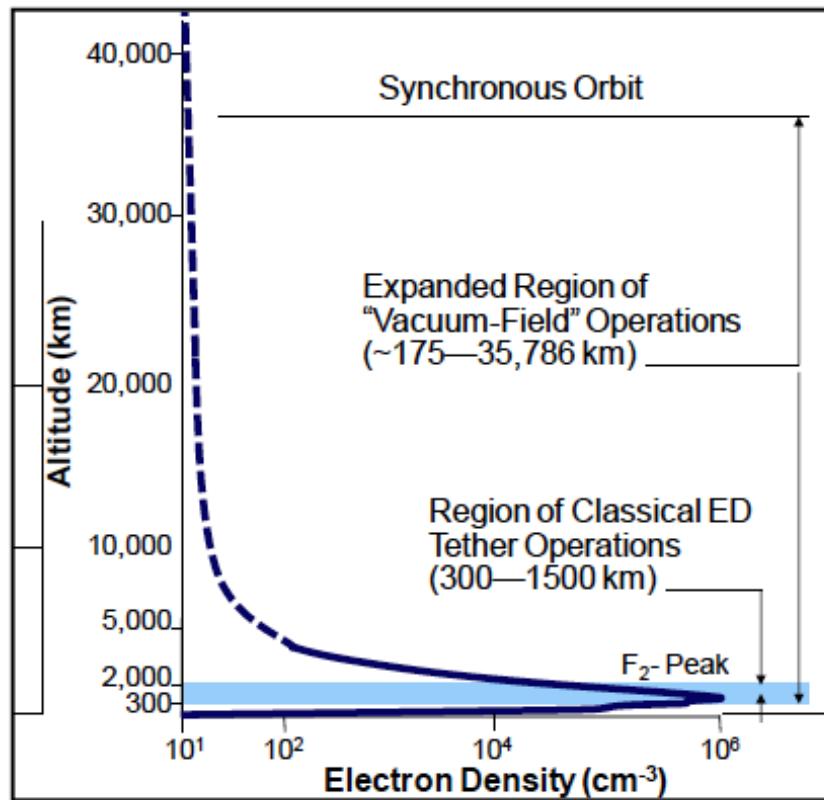


Ultralight High Performance Coatings

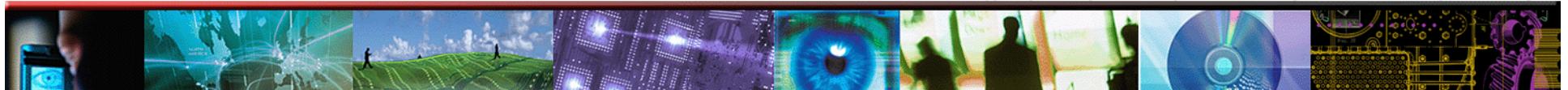
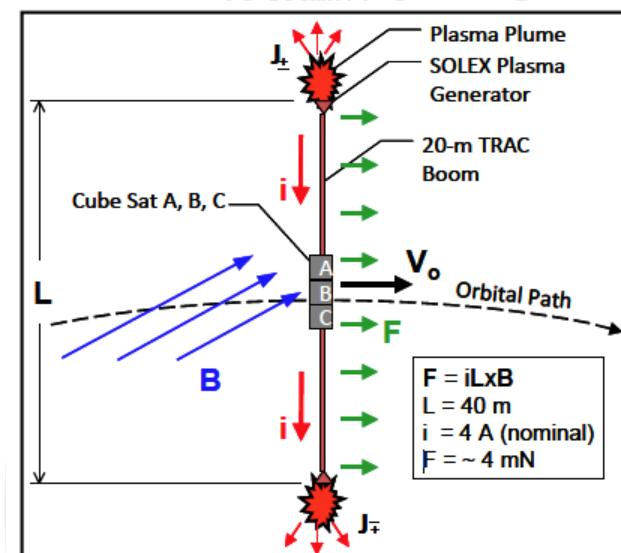
- “Thinner than min-gauge”
(2-5 micron thickness vs 25-75)
- Space mirrors on thin films
- Unrivaled performance



Electrodynamic Propulsion Operations Beyond the Ionosphere



SOLEX - Solid Plasma Contactor



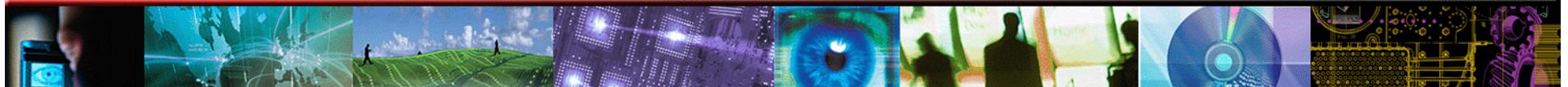
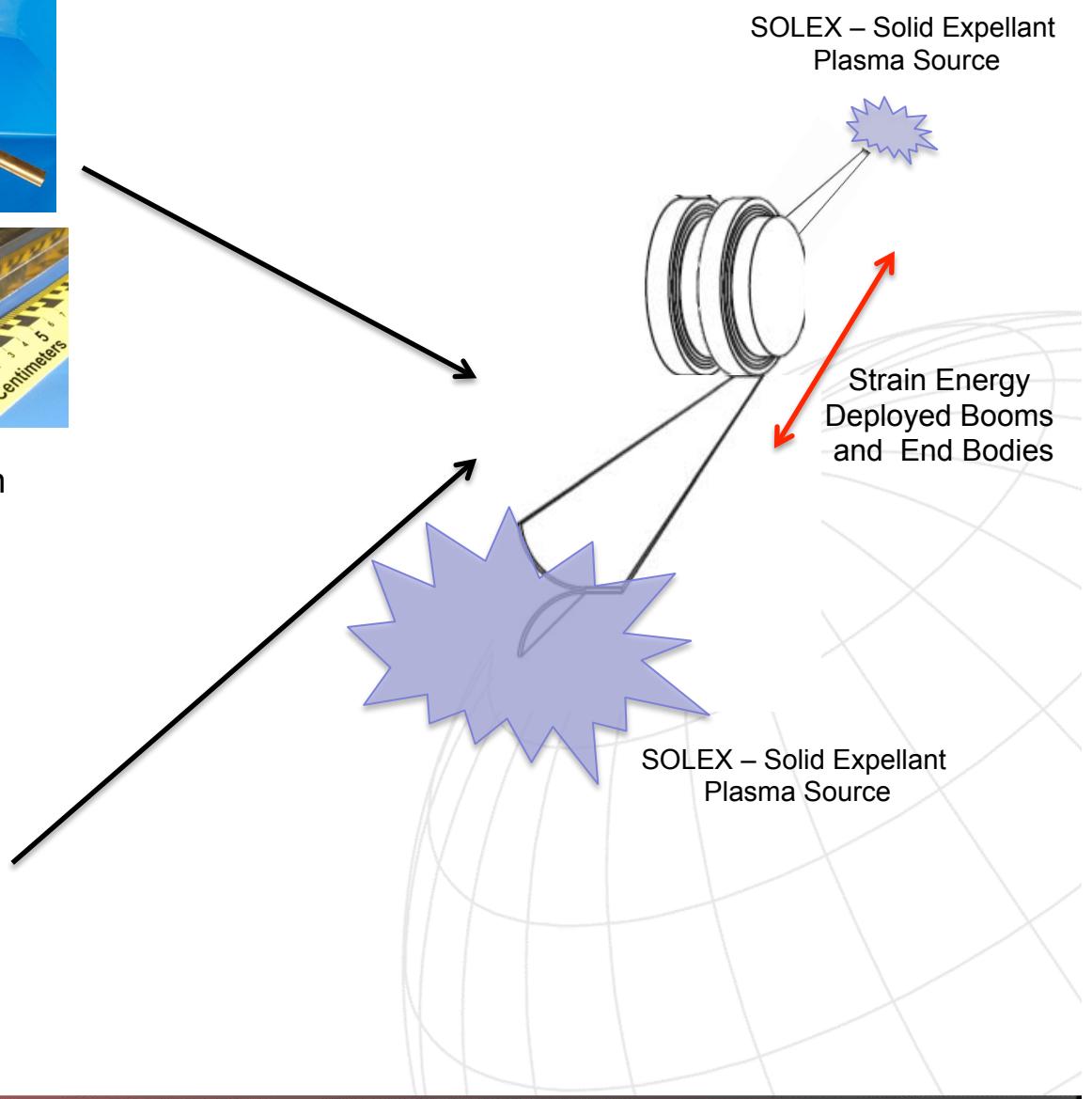
Novel Combination of Architectures for ED Propulsion



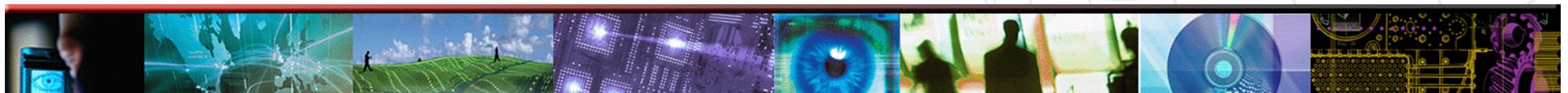
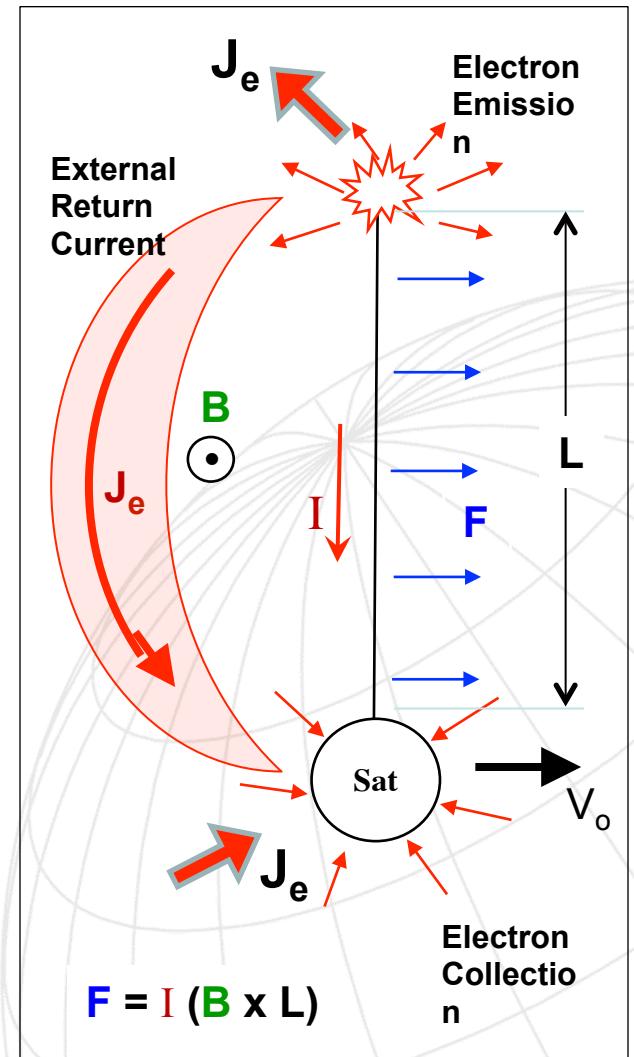
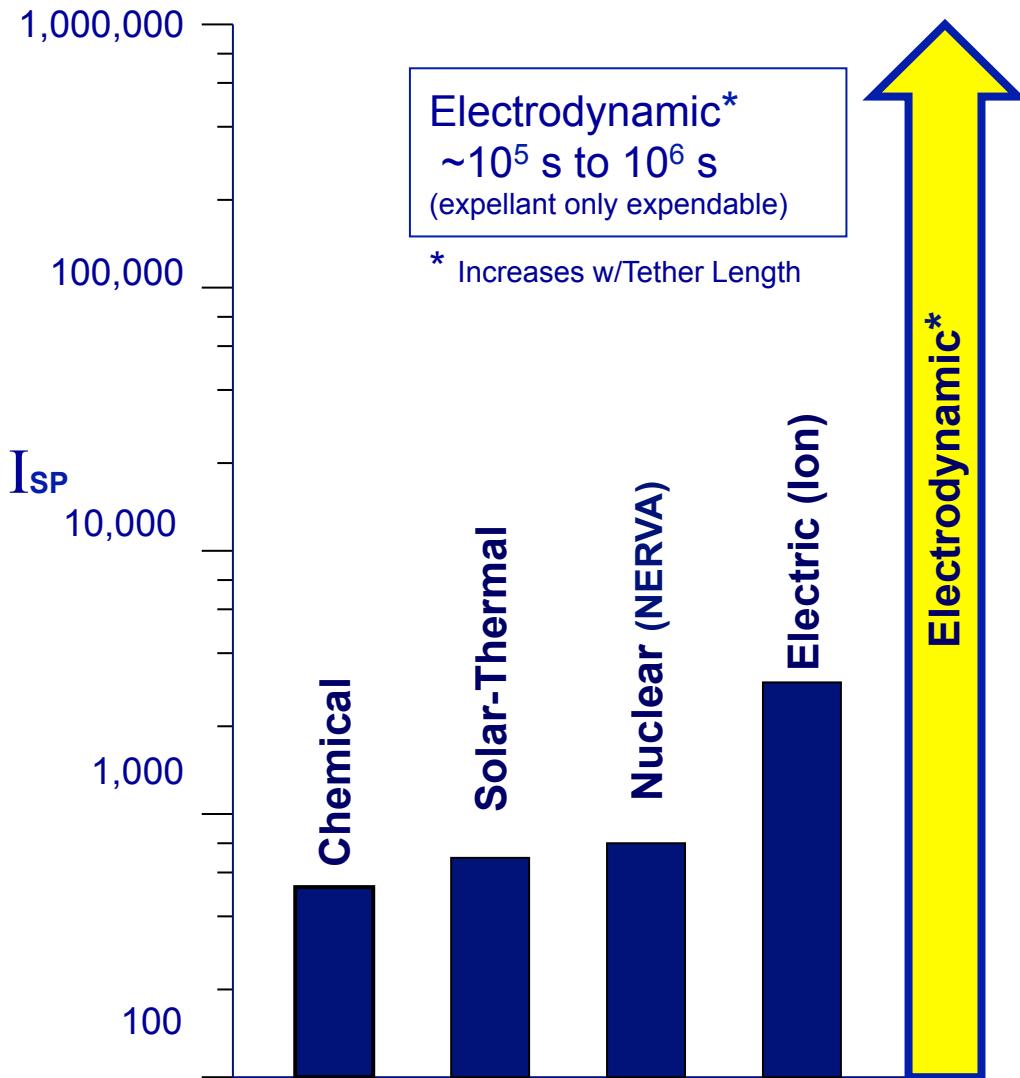
TRAC boom systems demonstrated on
Nanosail-D



SOLEX – Solid Plasma Contactor
(expellant block shown)



Propulsion Advancement Enabled by ED Technology



Primary Results from ElectrodynamiC Tether Missions

Electrodynamics

- Current collection in space *ten times more* efficient than predicted (TSS-1R)

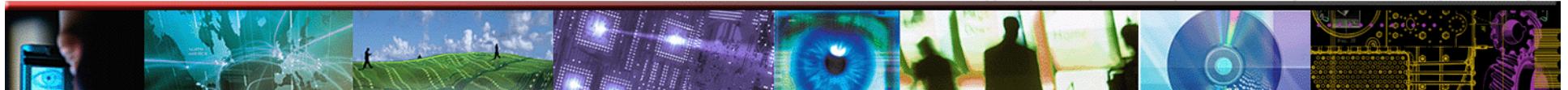
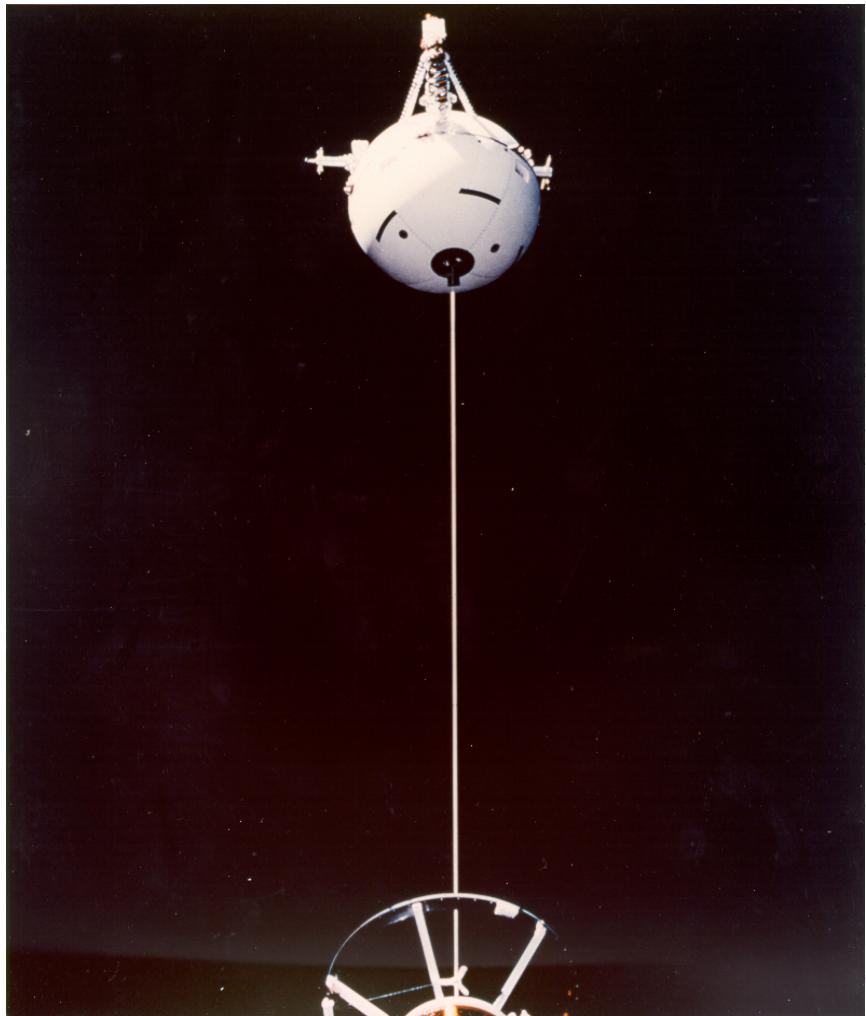
Even greater efficiency obtained w/ gas emissions. Pre-TSS theoretical models much too conservative.

- Energy conversion from spacecraft orbit into electrical (unconditioned) power demonstrated (TSS-1R)

A peak power of > 3.5 kW was generated.

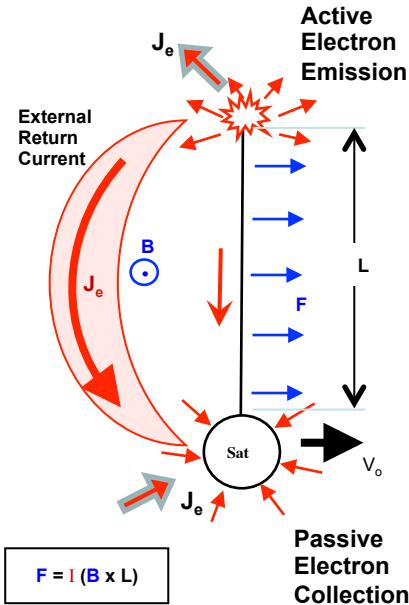
- Bi-polar operations (PMG)

Polarity and current flow reversal performed, demonstrating power generation and propulsive thrust modes.

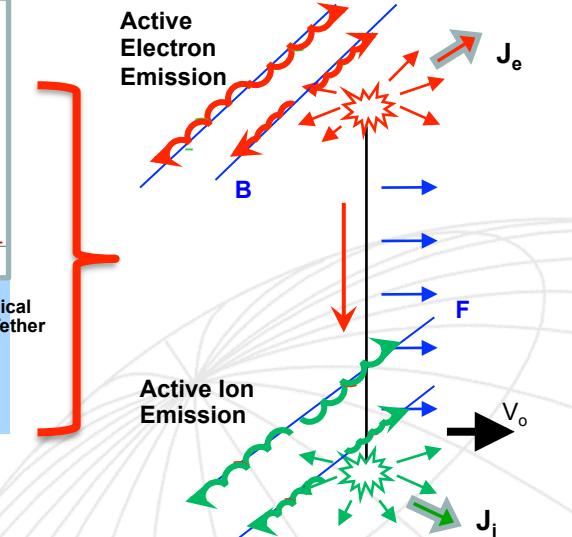
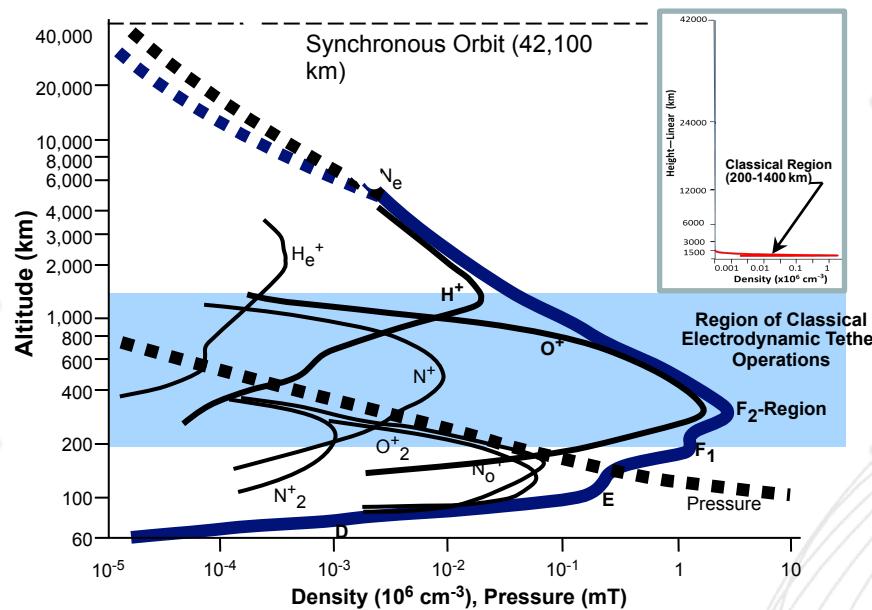


A Potential Solution:

Vacuum-Field Electrodynamics (VFE)

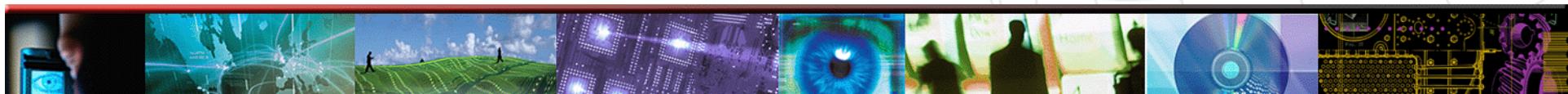


**Region of Classical
Electrodynamic
Tether Operations**

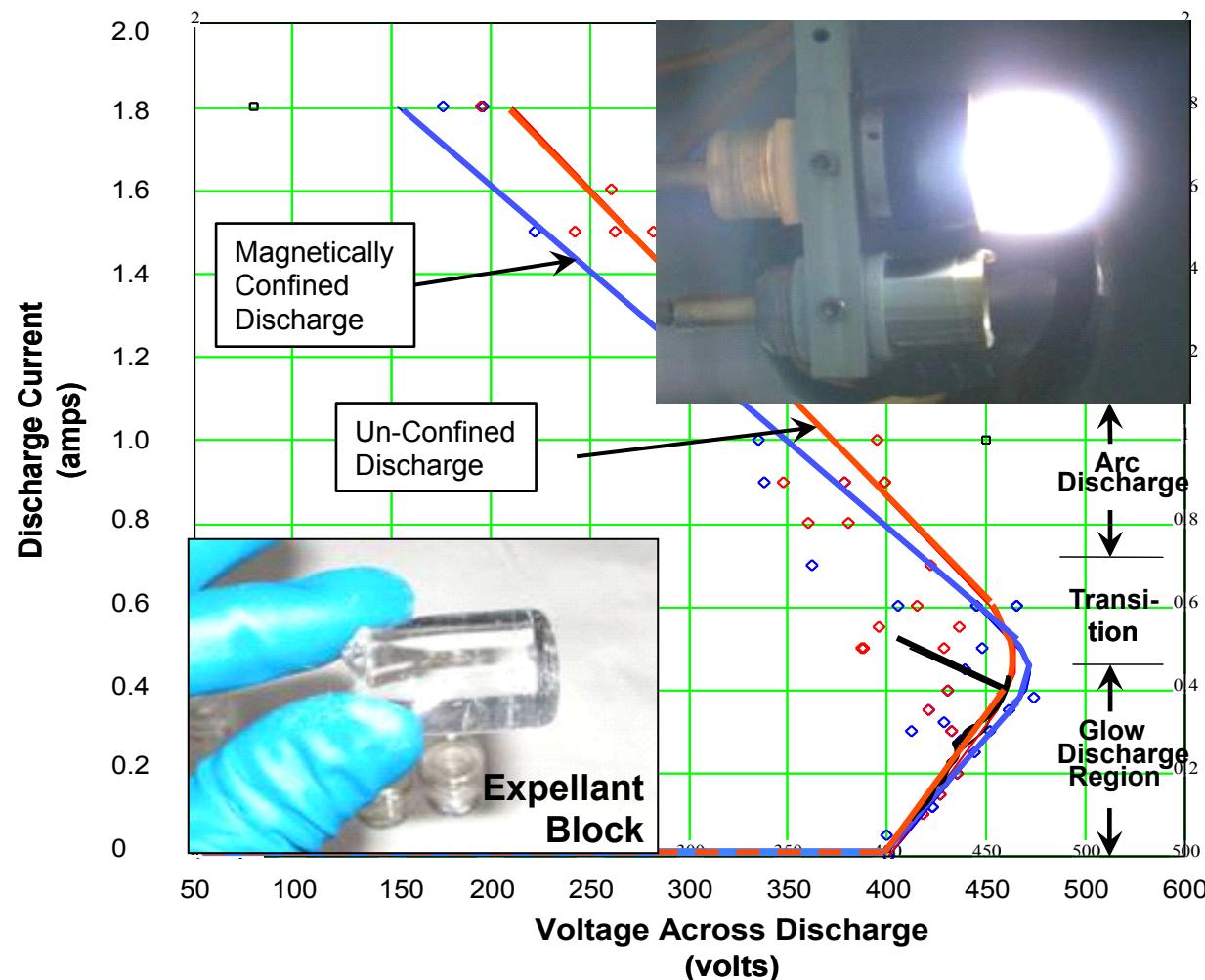


**Expanded Operations
with Vacuum Field
Electrodynamics**

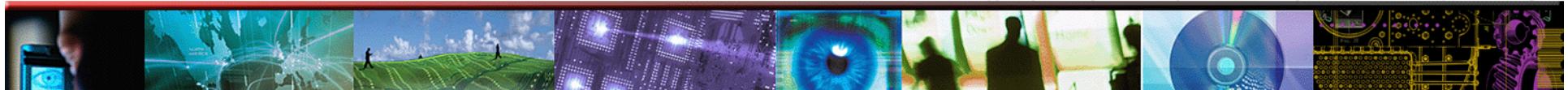
- SOLEX – Solid Expellant Plasma Source provides expanded operations outside of the classical tether operational altitudes.
- Provides active emission at both ends of tether (ions and electrons) through use of consumable solid expellant block.



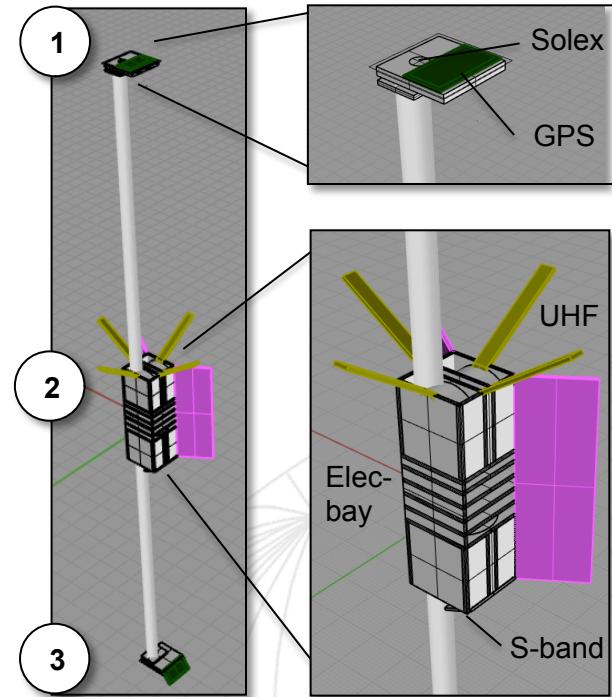
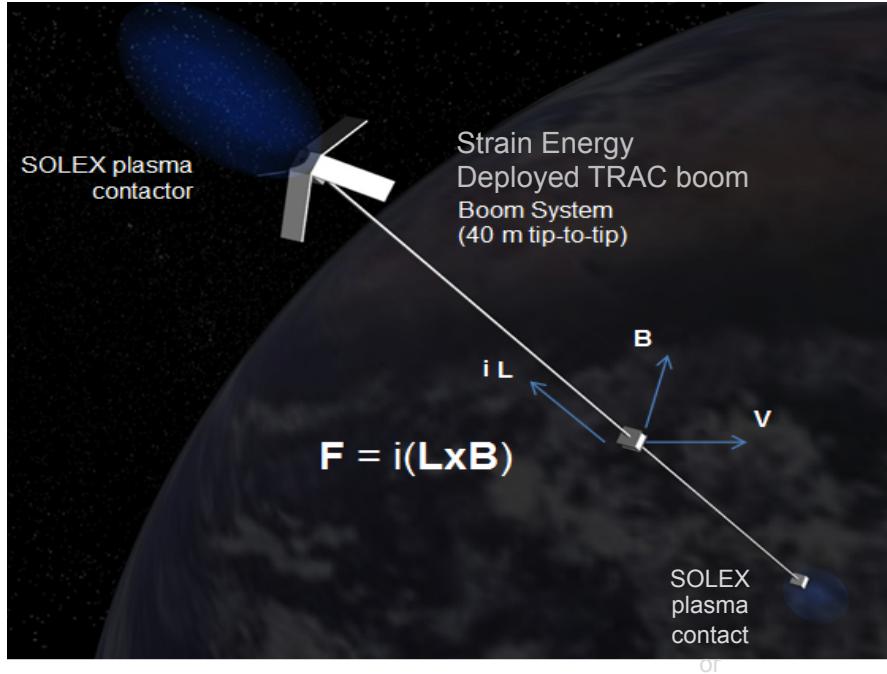
SOLEX - Current-Regulated Plasma Source



SOLEX – Vacuum Test Data and Proof of Concept



An initial proof of concept - Cubesat Subsystem Layout



- Active generation of plasma and *emission* of charge at each pole of the boom system
- Rigid conductive deployable boom – shorter in length and mitigates tether specific issues
 - Lower dynamic drag enabling low altitude operations
 - Exploits flight proven boom technology (NSD) and system length and volume capabilities

- 1.) Zenith endbody – Solex, GPS antenna (green), Boom attachments
- 2.) Bus Body— boom spools and HV electronics, electronics bay, deployable PV panels (purple), S-band antenna (green-nadir facing) and UHF tape spring antennas (yellow)
- 3.) Nadir endbody – Solex, GPS Microstrip antenna (green-deployed upward), boom attachments

